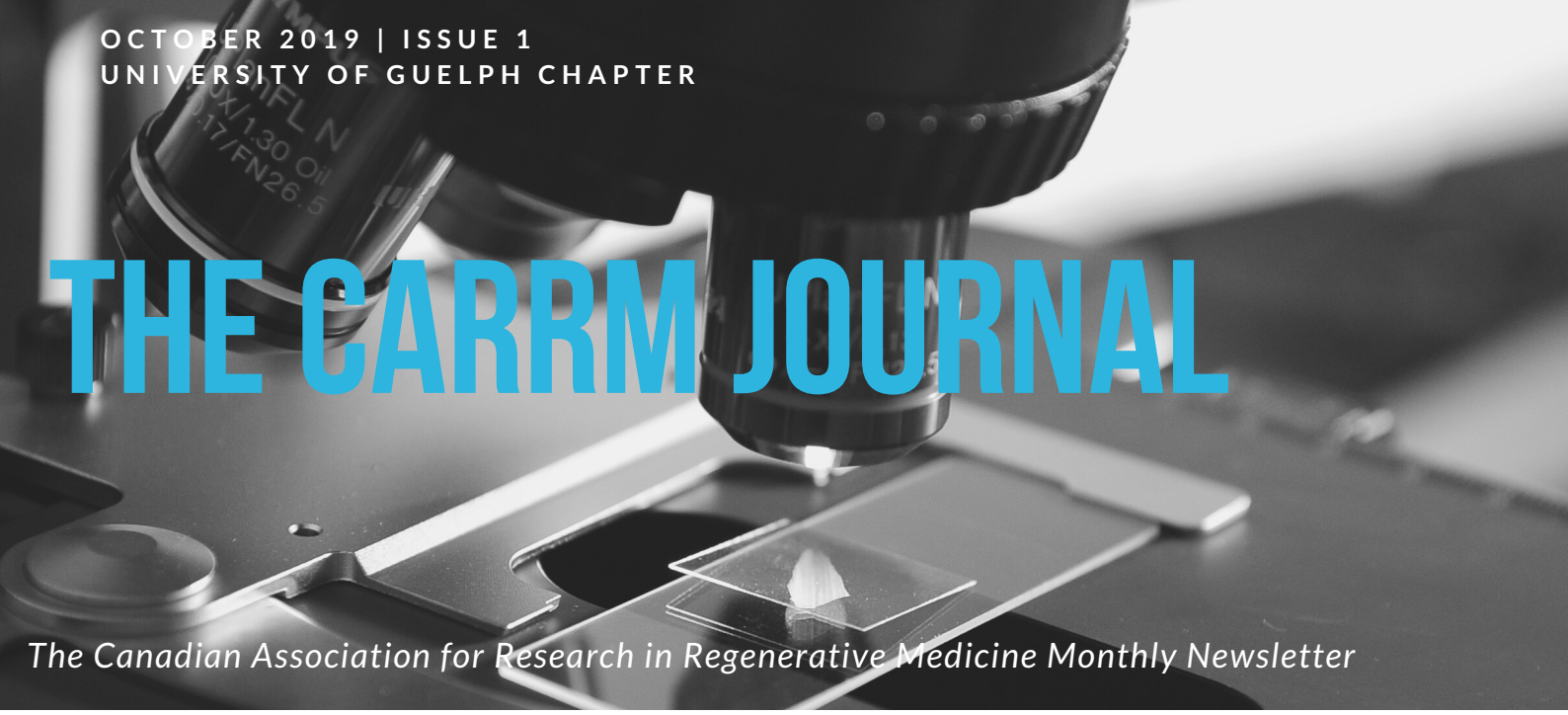
OCTOBER 2019 | ISSUE 1
UNIVERSITY OF GUELPH CHAPTER



THE CARRM JOURNAL

The Canadian Association for Research in Regenerative Medicine Monthly Newsletter

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GENOME IMMUNITY IN GERM CELLS

Kainaat Fatima, Bio-Medical Sciences, 2nd Year

A retrovirus is a form of bacteria that inserts a copy of their DNA into the host cell, altering the DNA of the host. It is a rare occurrence in nature when the viral DNA inserts into the germline cells of the host, causing the viral DNA to pass along in generations. Around 8% of the human genome is viral DNA, which has thought to insert into the germline similarly. However, given the dramatic changes that such a process can have in altering the genome of future progeny, inevitably, the germ cells should have a mechanism of protecting themselves against this.

KoRV-A is a type of retrovirus that has recently found to infect Koala bears in Australia. KoRV-A effects both the somatic and germ cells of Koalas; though, the DNA of germ cells has been found to display an immune response to distinguish between viral and host DNA. The mechanism allows them to break down into unspliced viral RNA into sense piRNAs, which block the formation of the virus. It appears this mechanism could be shared amongst a wide range of species, including humans.

Research by Yu et al. (2019) involved analysis of testis, liver, and brain cells of two Koala bears. The use of several types of cells allows for a comparison between somatic and germline cells. High levels of piRNAs were found in the testes of the koalas in contrast to somatic cells. Findings by Yu et al. (2019) demonstrate that the majority of piRNAs formed from unspliced pre-mRNAs despite spliced mRNAs of the retrovirus being five times more abundant. Production of sense piRNAs formed by processing of the transcripts of viral insertions and seem to act as a precursor to the creation of antisense piRNA production. Transposons are regions in the DNA that can change their position in the sequence, resulting in the formation of mutations and alteration of the genomic sequence. Antisense piRNAs provide adaptive immunity against such transposons, which is specific to certain sequences on the genome. However, sense piRNAs defends the germ cells against the virus until antisense piRNAs are produced.

Further research must be conducted regarding this matter to determine a more detailed insight into the mechanism of genome immunity in germ cells. Research on a larger sample and a greater variety of koalas, such as female koalas, may provide a more detailed insight into whether this mechanism is similar in egg cells as well as sperm cells.

TEACHING, LEARNING, AND KNOWLEDGE TRANSFER

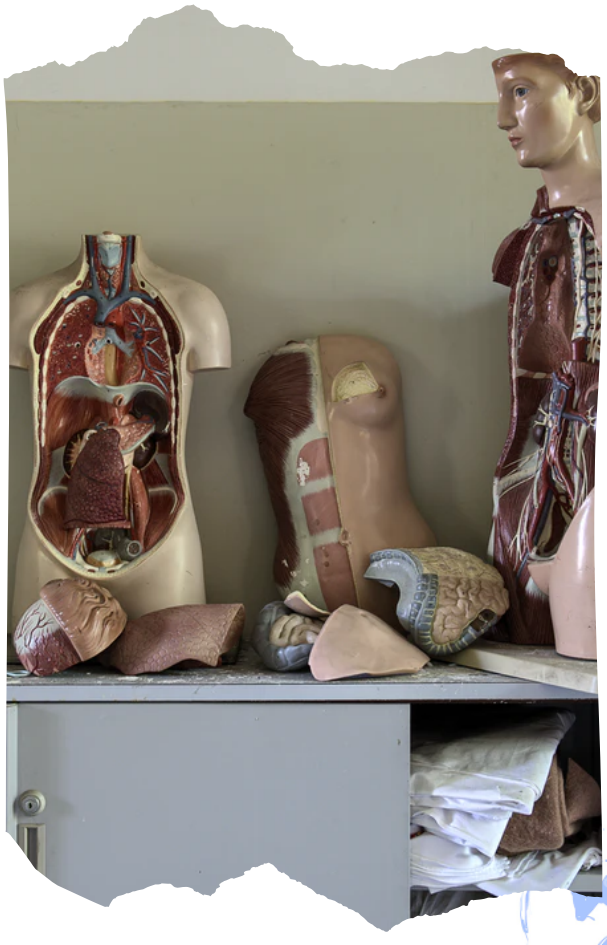
Pooja Ravi Sankar, Bio-Medical Sciences, 3rd Year

As a third-year student, I was nervous approaching my first fourth-year advanced research course. I am a biomedical science major and taking a variety of courses currently, one of the more distinct and unique than the rest. I am a part of a class that entails being in a team of sixteen students. This course is Teaching, Learning and Knowledge Transfer, and the name itself provides some background of what it is all about. The course involves students with interest in physiology and who have taken it in the previous year, including both third and fourth-year students. Students work in a team environment as well as one-on-one with their partner in tackling their specific units of interest, such as concepts regarding nervous system communication, hormones, the functioning of the Gastrointestinal tract and many more.

Through guidance from Human Physiology professors and the support of our course coordinator and Open Education Resources Librarian at the University of Guelph, we are operating towards inputting our work into an online platform through Press Books. The course is designed to foster critical thinking, creativity and teamwork to create a textbook guide. We hope to help students learn human physiological concepts better and in greater depth through the e-textbook project.

In physiology, there are certain concepts students often find more challenging, as it might require a more significant effort in understanding them. These refer to "sticky" points, and we aspire to address these points throughout the semester. We have initiated the process of identifying these sticky points. Our class is currently in the process of gathering various learning objects, which are open educational resources online that help support learning and can be easily accessible by students all over the web. In addition to providing accessibility, we have begun to learn and efficiently use the software while ensuring we interact with other students on it.

> The project has taught me to understand the value of being flexible and shift my perspective whenever it is needed. I am looking forward to this continued collaboration with my team members in integrating our gathered resources so that students can learn Human Physiology and enjoy the learning process!



SAY GOODBYE TO TRANSPLANTS - HELLO HEART OF FUTURE HUMANS

Anna Jedrzejczak

Today a barrier in heart disease is not the disease itself but the transplant list to get a heart. High demand for transplants and a shortage of organs can cause obstacles for those with heart disease. An approximate of 117,000 Americans (Mayo Clinic Foundation, 2019) are on the waitlist, and approximately 3000 of the latter die before receiving a heart (Mayo Clinic Foundation 2019). Regenerative medicine will create an era that phases out organ rejection and provides people with a custom heart on demand.

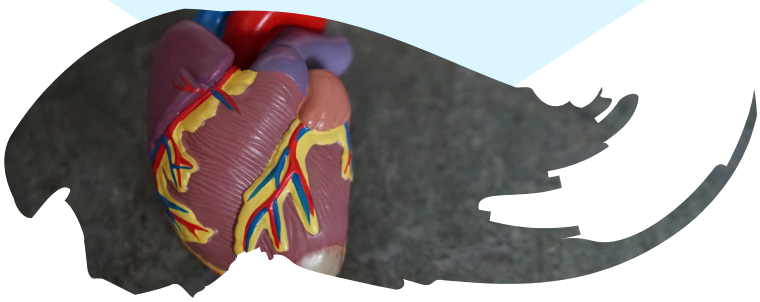
THE SCARY THING ABOUT TRANSPLANTS

If a patient does get a heart, the recipient is at risk of rejection by the recipient's immune system for the transplant since the immune system may detect it as a foreign object. Immunosuppressants are prescribed to reduce the activity of the immune system to the dismay of having to take them for the rest of the recipient's life (Mayo Clinic Foundation 2019). Unfortunately, 10% of people show signs of organ rejection even with immunosuppressants. Despite trying to prevent organ rejection, there are side effects of using immunosuppressants. Some of these can increase a person's chance of cancer or impairing the recipient's ability to fight off infections (Mayo Clinic Foundation 2019).

WHY DO PEOPLE NEED HEART TRANSPLANTS?

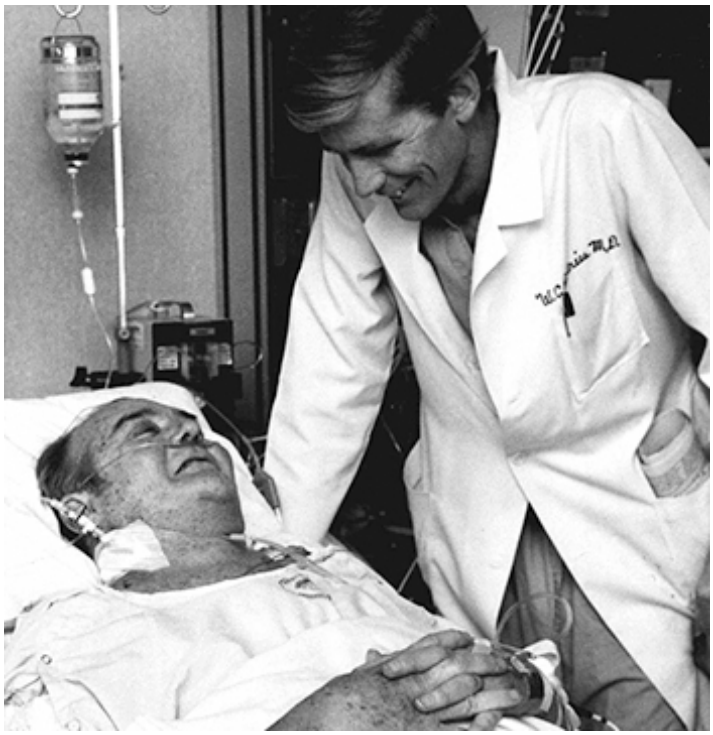
The treatment is for individuals who have tried several other medications, and surgeries and their health has not improved (Mayo Clinic Foundation 2019). In adults, several conditions can cause heart failure, including:

- Cardiomyopathy: a weakening of the heart muscle
- Coronary artery disease
- Heart valve disease
- Congenital heart defect
- Ventricular Arrhythmia: abnormal heart rhythms
- Heart attack (severe case)



THE HISTORY OF HEARTS - CURRENT ARTIFICIAL HEARTS

The first artificial heart implant was conducted in 1982 by William DeVries, a cardiac surgeon. Dr. DeVries removed the heart of Dr. Barney Clark and replaced it with the world's first artificial heart (Owens-Liston. P). The artificial heart was called Jarvik-7 after its inventor, Robert Jarvik. A 400-pound air compressor connected to the Jarvik-7, which accompanied Dr. Clark for 112 days until he passed away due to circulatory collapse and secondary multi-organ system failure (Owens-Liston. P). Today's artificial heart is 10 ounces, extending peoples' lives with implantation (of this device) called the left ventricular assist device (Owens-Liston. P). Though people can mechanize a 'working' heart, scientists wish that hearts become more 'organic' (Owens-Liston. P).



THE FUTURE OF CELL THERAPY - STEM CELLS

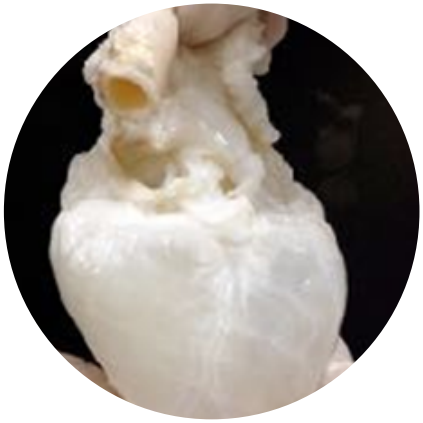
Cell therapy is a new technique that we now consider for the treatment of cardiovascular diseases collectively (Doris A. Taylor, & Matthew J. Robertson). The hope is that the stem cells or progenitor cells (a cell that is 'pushed' to transform into the target cell) will go to the site of injury and repair any damage (Doris A. Taylor, & Matthew J. Robertson). Originally, stem cells were thought to arise solely from an embryo (Lee. R & Walsh. K). However, since the study conducted by Yamanaka, and John Gurdon, showed the discovery of mature cells reprogrammed to pluripotency (primarily stems cells), proven by reprogramming the cells in frogs, (Lee. R & Walsh. K). Currently, cells are known for arising from other areas of the body, called adult cells that reside in "adult tissues such as bone marrow, the hair follicle, and intestinal epithelium," (Lee. R & Walsh. K).

Moreover, adult cells have the capacity of self-renewal and differentiation. Adult cells are believed to specialize in cardiac stem cells, though it is not entirely justified. This concept could lead to, "autologous [cells obtained from the same individual] cell transplantation for heart failure analogous to the widely used hematopoietic [production of blood cells, and platelets in the bone marrow] stem cell approach," (Lee. R & Walsh. K). Also, another approach is that rather than using hematopoietic stem cells, cardiac stem cells would be the better option. Cardiac stem cells are more generalized and can represent a heterogeneous population of cells. However, a small differentiation of cardiac myocytes, which are necessarily cardiac muscle cells, cannot express it (Lee. R & Walsh. K). Therefore, according to Richard Lee and Kenneth Walsh: "the potential for adult cardiac stem cells may have been overstated, as recent data do not indicate that the adult mammalian heart has a highly regenerative stem cell population," (Lee. R & Walsh. K). Nonetheless, "stem cell and reprogramming technologies will revolutionize cardiovascular biology over the next generation. It is obvious that the ability to generate billions of cardiac myocytes, as well as other cell types, has the potential to replace damaged cardiovascular tissue by cell transplantation," (Lee. R & Walsh. K).

GHOST HEART

The newfound notion of eliminating the waiting list is to find an existing heart from a donor, or an animal heart (like a pig's heart) that is close to a human's. Next, is to flush out any existing DNA, fluids, and cells from the heart until all that's left of the heart is a protein scaffold that looks like a white heart, (Suchetka, D). Stem cells inject to the protein scaffold form the recipient. The ghost heart then begins to mature into a human heart (Suchetka, D). Doris Taylor has been working on this theory and has so far become successful in creating the hearts of rats and pigs (Suchetka, D). Scientists are hoping that custom human hearts, such as the ghost heart, will become customary for patients with heart disease.

Furthermore, patients will not have to take immunosuppressants for the rest of their lives as they have many adverse side effects such as an increased risk of high blood pressure, diabetes and kidney failure (Suchetka, D). Also, patients would not have to wait years for a heart when it can be custom made for them in 4 weeks (Suchetka, D). The ability to create a heart from scratch can prevent many issues that arise from transplants alone.



MEET A CARRM EXECUTIVE

GUELPH CHAPTER PRESIDENT - JOCELYN LEE

Jocelyn is in her fourth year studying Bio-Medical Science at the University of Guelph. She became fascinated with regenerative medicine when she discovered its therapeutic potential for such a wide range of diseases. Jocelyn became further interested in the field when she began undergraduate research studying the effects of nutraceutical supplementation on the proliferation and differentiation of various stem cell lines. She hopes to learn more about regenerative medicine in graduate studies. In her free time, Jocelyn likes to nap and antagonize her two pets, Rosco and Muffin.

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